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PULMONARY HEMORRHAGE IN THE TUBERCULOUS AT HIGH ALTITUDE (6,200 FEET); REPORT OF 56 DEATHS; FREQUENCY OF ASSOCIATED HEART DISEASE.

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A review of the clinical records of the Marine Hospital Sanatorium at Fort Stanton, N. Mex., shows that since it was opened, in 1899, 56 deaths from pulmonary hemorrhage have occurred there. All of the subjects were under treatment for tuberculosis of the lungs, and together they constitute a little more than 10 per cent of the total mortality from that disease. The histories of all cases, where the hemorrhage was not immediately fatal, were passed upon by three medical officers before being admitted to this series, the facts in each case being considered sufficient to place hemorrhage in a causal relation to death. Instances where hemorrhage may have sown a new crop of tubercles throughout the lung, death occurring several weeks later from a rapid extension of disease, have not been included, nor has death been ascribed to hemorrhage in any instance simply because it was a sequence of that accident. Two fatalities from ruptured aortic aneurism occurring in tuberculous patients are also omitted.

Age.

	Total deaths from tuberculosis of lungs.		Deaths from pulmonary hemorrhage.	
	Number.	Per cent.	Number.	Per cent.
Number of patients less than 20 years old	8	1½	2	3½
Number of patients between 20 and 30 years old	180	35	19	34
Number of patients between 30 and 40 years old	169	32	20	36
Number of patients between 40 and 50 years old	116	22	9	16
Number of patients between 50 and 60 years old	39	7½	4	7
Number of patients more than 60 years old	12	2	2	3½
	524	100	56	100

All patients at Fort Stanton are adult males, the great majority between the ages of 20 and 50 years. Referring to the table above it will be seen that variation in the frequency of deaths from hemorrhage corresponds fairly closely with that of the total number of deaths from tuberculosis of the lungs in each age period.

Syphilis and alcohol.

	Syphilitic history.		Excessively alcoholic.	
	Number.	Per cent.	Number.	Per cent.
Number of patients admitted (1,754)	245	14	491	28
Hemorrhagic cases studied (453)	71	16	133	29
Total number of deaths (527)	79	15	158	30
Number of deaths from hemorrhage (56)	12	21	19	34

Fourteen per cent of all patients gave a history of syphilis, although the disease rarely appears in active form here. The preliminary observation to which they are subjected in the local marine-hospitals before being transferred is helpful in eliminating nontuberculous complications. Fifteen per cent of all those who died and 16 per cent of all those who had pulmonary hemorrhages were syphilitic, from which we may conclude that a previous infection with syphilis seems not to have much bearing on either the incidence of hemorrhage or the death rate from tuberculosis. Twenty-one per cent of those dying from pulmonary hemorrhage were syphilitic. A reference to the table shows about the same variation in those entering with a history of excessive alcoholism. As far as they go, the figures would indicate that damage to heart and vessels resulting from previous disease and excess is contributory to the frequency of death from pulmonary hemorrhage.

It is probable that alcoholism would show a more pronounced influence, at least on the total number of deaths, if it were not for the fact that a lapse to alcoholism while under treatment usually results in the discharge of the patient as a disciplinary measure. Inebriates, therefore, tend to eliminate themselves more frequently than do the temperate, before either their disease is arrested or death occurs. It may be mentioned that it is the policy at this sanatorium to secure either an arrest of disease or else, in the interest of the public health, to encourage the patient to remain here until death.

COLOR.

The negro seems to be slightly less liable to hemorrhage than the white. A previous study of our hemorrhagic cases[a] seemed to show that a chronic type of pulmonary tuberculosis is more common among hemorrhagic cases than among nonhemorrhagics. Those in whom the disease runs an acute course, as the very young and the negro, are less apt to have hemorrhages, because, instead of living for many years with pulmonary vessels exposed in cavities to tuberculous, pyogenic, atheromatous, or other destructive process, they die of their disease quickly, with opportunity for hemorrhage in inverse proportion to the rapidity of the tuberculous invasion. About 35 per cent of our colored patients have hemoptysis, either before or after beginning sanatorium life, against 38 per cent of the white men. The total mortality has been 50 per cent among the colored and 28 per cent among the white. Five colored patients have died from pulmonary hemorrhage, a number representing 6 per cent of their mortality. Fifty-one whites died from hemorrhage, 11 per cent of their total mortality.

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[a] Hemoptysis in pulmonary tuberculosis.—Transactions of the fourth annual meeting of the National Association for the Study and Prevention of Tuberculosis.

Relation of size of hemorrhage to death.

	Hemorrhage immediately fatal.	Hemorrhage not immediately fatal.
Large hemorrhage	17	11
Moderate hemorrhage	11	2
Small hemorrhage	1	3
Amount unknown	7	4
Total	36	20

Hemorrhages of over 500 cubic centimeters have been classed as large and those less than 150 cubic centimeters as small. Forty-one of the fatal hemorrhages were known to be of considerable amount, while small hemorrhages were responsible for only 4 deaths, 3 from broncho-pneumonia, and 1 apparently from shock, the man being greatly frightened and losing consciousness at almost the first show of blood. In this case autopsy was omitted, and it is quite possible that inundation of the bronchi during syncope occurred and that the real cause of death was suffocation.

In 36 instances hemorrhage was immediately fatal. Of these the majority died of suffocation. Death usually occurred in less than ten minutes, and in only one of the hemorrhages classed as immediately fatal, where all the circumstances are known, was life prolonged thirty minutes. Two cases were found dead in bed, suffocation from insufflated blood being the apparent cause of death in each case.

Next to suffocation, cardiac failure was probably the most frequent cause of sudden death. While it is true, that, occasionally, a large amount of blood from the lungs may flow from the mouth of a composed patient without violent cough, the great majority of pulmonary hemorrhages entails tremendous exertions on the part of the subject to free his lungs of blood and preserve his life from suffocation. This labor, and a certain amount of asphyxia, especially in a panic-stricken individual, must throw considerable extra strain on the heart, disease of which, as will be noted below, was frequent in this series. If it shall appear that the results of pulmonary hemorrhage in elevated regions are more serious than those occurring at sea level, it is probable that the explanation will be found in the incapacity of the heart to withstand sudden exertion, and also in the higher mortality from pneumonia at considerable altitudes, two causes which are of course, dependent upon the same thing.

Circumstances.

	Hemorrhage immediately fatal.	Hemorrhage not immediately fatal.
Patient in bed	29	5
Patient walking about grounds	3	3
Patient in quarters, not in bed	2	3
Circumstances unknown	2	9
Total	36	20

Thirty-four fatal hemorrhages occurred while the subjects were in bed. Of these, 4 took place in the daytime, 9 at unrecorded hours, and 21 between 9 p. m. and 6.45 a. m. It is not unreasonable to suppose that a man surprised during sleep by a hemorrhage is more apt to succumb to suffocation than one in possession of all his faculties.

Eleven of those dying suddenly in bed were under treatment at the time for hemorrhage occurring a few days previously, but the hemorrhage which sent these same men to the hospital ward took place in bed in at least 6 instances. Of 13 hemorrhages immediately fatal in ambulant, afebrile patients, 8 occurred while the man was in bed for the night, while of 19 hospital patients dying suddenly, including the 11 mentioned above, 15 were in bed at the time.

In no case, where the facts are known, either among ambulant or bed patients, or even where hemorrhage had been of recent occurrence, was sudden exertion, straining at stool, bathing, etc., the cause of the fatal hemorrhage. One man, however, who was found dead in bed is known to have been intoxicated the day before, and another who died suddenly from hemorrhage was engaged in a heated argument at the time of the accident and was, moreover, suspected of having imbibed smuggled whisky.

In 21 cases not immediately fatal, 16 died of broncho-pneumonia, 1 of lobar pneumonia, and 1 of cardiac failure thirteen hours after a very severe hemorrhage. The last case was not autopsied. The pneumonia cases died, 1 on the second day, 5 on the third, 5 on the fourth, and 1 each on the fifth, eighth, fourteenth, sixteenth, and seventeenth days after hemorrhage. The two remaining cases died four and a half hours and seven hours, respectively, after the last of a series of hemorrhages which had continued in one case for seventeen days and in the other for two days immediately previous. Both were autopsied, and, in the absence of any grossly apparent cause, the deaths may be properly ascribed to exhaustion. Neither in these two nor in those others where hemorrhage was immediately fatal, while the subject was in hospital recovering from the effects of previous hemorrhage, was there evidence of broncho-pneumonia. This experience supports that recorded by at least one observer (Bonney), that recurrence of hemorrhage is rare after broncho-pneumonia has developed.

Duration of treatment compared with that of other fatal cases.

	Total deaths from pulmonary tuberculosis.		Deaths from hemorrhage.			
	Number.	Per cent.	Number.	Per cent.	Previous hemorrhage.	No previous hemorrhage.
Deaths within one month after admission	84	16	9	16	7	2
Deaths occurring from one to six months after admission	203	39	14	25	8	6
Deaths occurring from six to twelve months after admission	93	18	11	20	7	4
Deaths occurring from one to two years after admission	87	16	10	18	7	3
Deaths occurring more than two years after admission	57	11	12	21	8	4
Total	524	100	56	100		

The influence of chronicity on hemoptysis, referred to under the consideration of color, is again evident here. The percentage of deaths from hemorrhage as compared with that from other causes shows a steady rate of increase after six months' stay. If the previous duration of disease could be fixed with any degree of accuracy the total duration of the disease would be a more proper basis for calculation in this connection; but, as is well known, the date of onset is extremely uncertain. The above table would seem to indicate that the institution which retains individual cases longest will have the largest percentage of deaths from hemorrhage.

The earliest death from hemorrhage was one immediately fatal, occurring on the seventh day after arrival, in a patient with a history of pulmonary hemorrhage previous to admission. Of the 9 dying within a month after arrival, 7 had a previous history of bleeding, and 2 died of their first hemorrhage. Five of these cases were immediately fatal and 4 were not. Of the 12 who had been here over two years, 4 died of their first hemorrhage. Eight of these deaths were immediate and 4 succumbed to broncho-pneumonia.

Of the 19 dying of their first hemorrhage, 14 succumbed immediately, 7 had been at Fort Stanton over one year, and 3 more than three and a half years.

Epidemicity.—Occasionally a number of fatal hemorrhages have occurred within a few days. For instance, there were 14 deaths from that cause in the year 1907, 2 within two days in January, 4 within seventeen days in April, 3 within twenty-one days in November. The other 4 took place one each in as many other months. The apparent epidemic nature of hemorrhage from the lungs has been frequently noted and various efforts made to explain it. An occasional grouping of cases is surely no more remarkable than an even distribution would be and is a phenomenon by no means confined to contagious diseases.

Stage of disease.—All of the 56 cases were far advanced, according to the nomenclature adopted by the National Association. Forty-three were so classified on admission and the remaining 13 came as moderately advanced cases, but had progressed to the third stage before death. Excavation, in most cases extensive, was found in each of the 43 autopsied, and cavities had been demonstrated clinically in all the others.

Condition at time of fatal hemorrhage.—In 46 instances the disease was known to be progressing, while 10 patients were supposed to be arrested cases. Nine of the latter were autopsied and while in 6 of these only slight evidence of active tuberculosis was found and while there was ample evidence of healing, none of them could properly be called arrested in the sense that all activity had ceased in all parts of the lungs. Each had a few small, thick-walled cavities, considerable scar tissue, and abundant healthy lung remaining, but careful search revealed in all either a few scattered tubercules of recent deposit or some minute area of softening. But the fact that 6 such cases succumbed to hemorrhage would indicate that that event is sometimes an accident, irremediable, unavoidable, and not to be foretold.

The ruptured vessel responsible for the fatal issue was found only nine times in 43 autopsies. In each instance the vessel was partially exposed in a cavity. Six times the rupture occurred in an aneurismal dilatation, presumably of a branch of the pulmonary artery; three times no dilatation was noted. The occurrence of small, unruptured aneurisms projecting into cavities is not an unusual finding in our autopsies.

In an effort to locate the site of hemorrhage, tracheal injections of colored gelatine were made in a number of cases. In one the injected material was found at autopsy filling the arch of the aorta, but not present in either side of the heart, indicating, possibly, hemorrhage from a bronchial artery, the location of which, however, could not be determined.

Cardiac disease.—The condition of the heart was described forty-two times in 43 autopsies. Valvular disease of the heart with incompetency of the mitral valve was found four times, once associated with aortic stenosis and once with an acute pericarditis and effusion; all four were immediately fatal cases. Aortic incompetency in a small heart showing brown atrophy and with adhesions of the pericardial sack to the right pleura was found once; fatty degeneration of the myocardium once; dilatation of the right auricle in a heart weighing 545 G. once—all in cases dying immediately. Disease of the mitral valves not resulting in incompetency occurred five times, the hearts weighing 385 G., 450 G., 385 G., 250 G., and 320 G., respectively; disease of the aortic valve not resulting in incompetency was found once in a heart of 380 G. All these were also cases where the hemorrhage proved immediately fatal.

Tricuspid incompetency occurred once and dilatation of the right ventricle twice (all in different cases), one of the last in connection with excrescences on the mitral valve and all in cases dying of bronchopneumonia. Another case with greatly enlarged heart (735 G.) and extensive pericardial adhesions also succumbed to this sequel to hemorrhage.

Thus 17 of 42 autopsied are known to have had some serious cardiac disease; 13 of these died suddenly. The preponderance of left-sided cardiac lesions in the cases immediately fatal is noticeable.

Besides those mentioned above, three hearts showed small pericardial effusions of 100, 150, and 350 cubic centimeters, respectively; two enlarged hearts (360 G. and 480 G.) had extensive pericardial adhesions and another heart which produced a mitral systolic murmur in a subject who subsequently died suddenly from hemorrhage showed no disease except a few atheromatous patches on the mitral leaflets, but was associated with a small pleural effusion and an acute pleuritis with plastic exudate. Of the remaining hearts that were examined, 7 were hypertrophied, ranging in weight from 350 G. to 450 G. Thus only 12 hearts, 3 of which were not weighed, and so, perhaps, were not carefully examined, seemed normal out of the 42.

COMPARATIVE FREQUENCY OF HEMOPTYSIS AT HIGH AND LOW ALTITUDES.

It has been scientifically established that blood pressure is lowered with increase of altitude, and while elevated places have never been considered unsuitable for the treatment of cases of pulmonary tuberculosis showing hemorrhagic tendencies, a note as to the comparative frequency of hemorrhages from the lung at this sanatorium may properly be added here. Our altitude is 6,231 feet; most patients arrive from places at or near sea level.

Of the first 453 hemorrhagic cases admitted, 248 had hemorrhages before but not after admission; 106 had hemorrhages both before and after admission; 99 had hemorrhages after but not before admission.

Such data are obviously not of much value without knowing how long the patients were under observation.

Of 248 having hemorrhages before but not after admission, 31 remained over two years, 46 remained from one to two years, 45 remained from six months to one year, 61 remained from three to six months, and 65 remained less than three months.

This still is not conclusive, because the duration of the disease before entering was probably greater in most cases than the time patients remained under treatment here, with consequent greater opportunity for hemorrhage before than after admission. But taking into account the well-known frequency of recurrence in pulmonary hemorrhage, the belief that elevated regions are favorable for the treatment of ordinary hemorrhagic cases of tuberculosis of the lungs would seem fairly well supported.

SUMMARY.

1. Hemorrhage from the lungs is responsible for about 10 per cent of the total mortality from pulmonary tuberculosis at this sanatorium.
2. Syphilis and chronic alcoholism increase the liability to fatal hemorrhage.
3. Small pulmonary hemorrhages are rarely suddenly fatal, but may cause a dangerous insufflation pneumonia.
4. Recurrence of hemorrhage rarely or never occurs after bronchopneumonia develops.
5. No age period of adult manhood seems especially predisposed to fatal pulmonary hemorrhage.
6. Exciting cause of fatal hemorrhage was noticeably absent; the majority of subjects were in bed at the time and a large number presumably asleep.
7. Acute types of pulmonary tuberculosis are least liable to this accident; negroes showed a lower mortality from hemorrhage than whites.
8. Hemorrhage has not been common immediately after arrival from sea level; the increased mortality from hemorrhage after prolonged residence at high altitude may properly be ascribed to the chronic type of disease in these individuals.
9. Disease of the heart or embarrassed circulation from any cause predispose to a fatal issue when pulmonary hemorrhage occurs.
10. Pulmonary hemorrhage is not more frequent at high altitude than at sea level but the results are perhaps more often serious, especially in those with impaired circulation.